5C: Plankton and Nutrients

Questions & Answers

Q: Tim Determan's plot of the paralytic shellfish poisoning was most interesting to me. I just remember looking at our PSAMP data for the Hood Canal, Holmes Harbor, and Penn Cove that those tend to be areas that have low DO in the late summer, and as a non-biologist, I kind of wonder if maybe there are any other vital plankton that are out competing Alexandria and I just wondered if there were any other hypotheses. Maybe a real biologist could tell me some other things. It seems that those areas are the same ones that have the lowest DO.

A: Well, I'm not a real biologist. I'm more of the nuts and bolts oceanographic type. Any biologist here could field that question. We don't have any implications at this point.

A: I think it's too soon to say. What regulates species succession is a classic question that we really struggle, as oceanographers, to try to answer because the environment is so complex. But as get better methods of detecting these things, some of the things that Vera is going to be speaking on, and some of the research. I'm going to put a plug in for Dr. Ginger Armbrust at University of Washington School of Oceanography. She's been using some molecular techniques to look at why one species develops vs. another. Combining that with the environmental idea I think we might get some answers. And I see Tim has thought of something.

Determan: I think people should keep in mind that we're looking at PSP toxins in shellfish and so whether you can take this data and translate it into what's going on in the water column is a matter of some question because we have to deal with the physiology of the shellfish as well the conditions in the water. This is a point I'd like to make particularly for the south Sound blooms that occurred this year. It's entirely possible that that late season bloom occurred and the shellfish took the stuff in. If the temperature dropped (and we have to take a look a the temperature data here), it could be that the pumping, filtration rate of the shellfish dropped and they essentially just held on to what they had for a longer period of time. So we've got to be kind of careful in making these shifts in thinking about PSP in shellfish tissue to what's going on in the overlying water column.

Forbes: I just want to reiterate that Beth spent three years working with me in the southern Gulf Islands looking at toxins or harmful algae in the water column and a number of oceanographic factors, and one the things that we were trying to do was to relate that to the Canadian paralytic shellfish poisoning monitoring program. In fact, we found very little correlation between high levels of *Alexandrium* that we found in the water column compared to nearby PSP monitoring sites. I think that PSP is very much localized in some environments and you cannot make a very clear link between harmful phytoplankton in the water column and toxicity in the nearby shellfish beds. But it's very difficult to make that link.

Q: Beth, I think the work you've done is really interesting and it may be highly significant when you compare, and I realize the data sets may not be there, those kinds of shifts in timing like that they're very reminiscent of some of these other interdecadal kinds of shifts we've seen, obviously, in the larger atmospheric conditions, but when you look at things like oyster condition, how fat the oyster is in its shell, salmon returns and all that, have you considered looking at some of those other factors and correlating them?

Bornhold: Yes, we're going to try and collect some of those data sets next. We just saw this change and have kind of gone with that for now. And that's what I say, look at the other shifts and try and compare and see if we're seeing other shifts.

Q: Paul, I know the paradigm right now is that nitrogen is one of the macronutrients that is controlling phytoplankton in Puget Sound, but have you given any thought to some micronutrients maybe being supplied by urban run off, sewage treatment plant, either some other some element, some vitamin or organic component?

Harrison: Did you have a particular one in mind?

Q: I've often said iron.

Harrison: Yes, iron is important now offshore, well offshore in the north Pacific, but not in the coastal regions. We get enough input, so that's not a problem. The next one likely to be limiting is phosphorus. If you do any bioassays, if you just look at any data, usually when the inorganic nitrogen is low and that's usually for a very brief time, a few days, often phosphate is sort of closer or close behind. One thing that is important and is quite interesting is coming out of the Fraser River when you measure nutrients in the plume, if you filter the samples which are really quite muddy, and then run the phosphate concentrations you find very, very low phosphorus concentrations. But if you don't filter them, and go ahead and do the analysis, you actually get quite high phosphorus concentrations. So there is a lot of phosphate absorbed to the sediments. We've done some preliminary bioassay work to show that quite a large portion of that phosphate absorbed to the sediments is actually biologically available on a slow basis. So I guess to answer your questions, number one would be nitrogen, number two would be phosphorus.

Amazingly enough, as I think Curt had suggested, silicate is quite high in the rivers. We have 60 micromolar coming out of the Fraser River. But periodically this can be drawn down to very low levels by the diatoms, which is quite amazing. So, of course, not all species need silicate, so you can go on and get dinoflagellates, so I think there's really nothing there in the micronutrient story.

And vitamins—I had a student do something with vitamin B-12, but I would be surprised if there's anything there. So it's mainly nitrogen dominated but only very brief periods of nitrogen limitation, quite amazingly enough. And even in the main part of Puget Sound I think because of wind mixing, they don't have the prolonged nitrogen limitation that you might find in other areas.

Comment: Well, I have to follow up with that and offer something I saw at ocean sciences, and if I hadn't seen the data myself, I would be pretty skeptical. Al Hansen had data from East Sound, and he's looking at iron concentrations and found that at a period in late July, or something like that, they had strong stratification and they actually found that iron was depleted in some of the zones due to this stratification. I also had to do with the oxygen content and what oxidation level the iron was in, whether it was bioavailable. He was making the case that you actually could find iron limitation in a place like East Sound, which was absolutely mind boggling to me. But I think it's some interesting research that we may be hearing more about.